CARE IN CAPTIVITY

Leopard Gecko, *Eublepharis macularius*, Captive Care and Breeding

Teresa Bradley,[1] DVM, David Nieves[2]

1. Belton Animal Clinic, 511 Main Street, Belton, MO 64012, USA

2. Reptile Education and Research, 8816 N. Charlotte, Kansas City, MO 64155

ABSTRACT: Leopard geckos, *Eublepharis macularius*, have become popular with both experienced herpetoculturists and novice reptile owners. This paper characterizes the species and discusses environmental, dietary and reproductive specifications. A client education handout describing basic care, feeding and medical problems for which a veterinarian skilled in reptile care should be consulted is also included.

KEY WORDS: leopard gecko, *Eublepharis macularius*, husbandry, breeding

INTRODUCTION

The leopard gecko, *Eublepharis macularius,* has become quite popular with herpetoculturists and in the pet trade. It is being presented with increasing frequency to veterinarians skilled in reptile care and medicine. This species has been successfully bred and reared in captivity by herpetoculturists (Goluber and Szczerbak, 1996) and by others less skilled. It is a hearty, insectivorous, nocturnal lizard that, with patient handling, is easily tamed. It is highly recommended for first time reptile owners.

Leopard geckos were first described in 1871 by John Anderson in the Proceedings of the Zoological Society of London (Goluber and Szcerbak, 1996). They are indigenous to southwestern Asia including Afghanistan, northwestern India, and Pakistan and found in arid to semiarid, rocky, scrub-type desert, fringe habitats. They are also known as Indian or Pakistani fat-tailed geckos, panther geckos, desert fat-tailed geckos, or spotted fat-tailed geckos. Leopard geckos are frequently cited as being from Iran and Iraq but do not occur west of Pakistan (Leviton, *et al*, 1992).

Geckos are the second largest family (Gekkonidae) of lizards with some 900 species. Leopard geckos belong to the Eublepharinae subfamily (or Eublepharidae family, depending upon your taxonomic viewpoint) which includes some 18 to 22 other species with a worldwide distribution. Eublepharidine geckos are primitive geckos compared to true geckos in that they have movable eyelids (Figure 1) and lack expanded pads or setae on their digits. They do however have well-defined claws that aid them in climbing rocks.

Leopard geckos possess a large tail slightly less than one half their body length. There are large fat stores in the tail which may provide a metabolic water source (de Vosjoli, *et al*, 1998). Fat stores may allow leopard geckos to go without feeding for longer than most lizard species. In the authors' experience they tend to thrive better than other lizard species in times of illness and stress because of this extra energy storage. As a defense mechanism the tail can be dropped off (autotomy) when attacked by predators, grabbed, pulled, or traumatized. The tail will regrow but will have a different appearance that is often smoother and more bulbous with a more jumbled pattern of spots (Figure 2). Regeneration of the tail takes from two to six weeks depending on the amount of tail loss and the age, diet and the health status of the gecko.

The color pattern changes significantly as leopard geckos mature. Juveniles are yellow with black or brown bands on their bodies and black and white banded tails (Figure 3). These bands are replaced by a spotted pattern as pigment cells migrate as the geckos mature. Adults have a yellow to tan background with patches of chocolate brown spots (Figure 3). The skin has many small wart-like growths or tubercles. Several color phases are acknowledged by herpetoculturists and selective breeding to bring out recessive color traits (Figure 4) is creating newer color phases. The two most common phases are the brown phase with a light tan background and the yellow phase with a yellow background. Patternless phases are also being developed.

Normal, healthy hatchlings are approximately eight and a quarter centimeters long and weigh 2 1/2 to 3 g. Leopard geckos reach adult size at nine to 18 months of age. They can weigh from 40 to 100 g and reach a total length of over 20 cm. Adult males tend to be larger than females.

GENERAL CARE

In the authors' experience the healthiest and best looking gecko is the one that is reared in an enclosure by itself. Social interaction does not appear to be necessary and often the competition for food and territory can be quite stressful among and between conspecifics and can lead to injuries.

Juveniles and adults should be housed separately to prevent cannibalism. No more that one male can be put in the same enclosure as they will fight and may even kill each other to defend territory. Breeders will often place several females in

with one male without much competition as long as hideboxes are provided for each lizard as a place for sleeping and a place to escape to in times of conflict.

A 10 gallon aquarium can be used to house from one to three leopard geckos. Up to four adults can be housed in a 20 gallon aquarium. Breeders will often house them in plastic sweater boxes with holes cut in the top. Keeping larger numbers in each enclosure necessitates more frequent cleaning of the habitat. The preferred day temperature in captivity has been reported as low as 20°C (68°F) (Goluber and Szczerbak, 1996) and as high as 30°C (86°F) (Mattison, 1991). However, these authors recommend a daytime temperature gradient from 21°C (70°F) to 30°C (86°F) with a slight decrease in temperature at night. Placing an under-tank heater on one side can create a temperature gradient from one side of the enclosure to the other. A light source can be provided during the day if additional heat is needed. Any changes in heat or light source in the microenvironment should be monitored carefully. If temperatures exceed 32°C (90°F) leopard geckos will become stressed, hyperactive, and dark in color. Above 38°C (100°F) they become moribund and death follows.

If additional light or heat sources are needed in the enclosures or when considering lighting in the room where the enclosures are kept, cool white or fluorescent bulbs should be used. Bright lights are stressful to geckos and seem to depress feeding. Light that is too bright may also keep them from being active during the day (Mattison, 1991). Ultraviolet or full spectrum lighting is likely to not be necessary, as they are a nocturnal species (Boyer, 1993), but may be helpful. It is the experience of these authors that the fluctuation in the North American day/night cycle can be adequate for raising leopard geckos, therefore additional lighting may not be essential. A 12 hour day/night cycle is sufficient.

Many herpetoculturists will use sand and gravel as a substrate. When selecting substrates, keep in mind that bedding material that can be ingested may cause intestinal impaction which can be fatal. The authors prefer to use newspaper, indoor-outdoor carpeting or plastic grass matting which are all easily handled for cleaning. Enclosures and matting can be cleaned as needed using dilute bleach water (1:30 solution in water).

As mentioned before, hideboxes must be provided. They can be made by using flat rocks that form a cave or an overturned plastic container such as a margarine bowl with a hole in it. Leopard geckos also need a dark, dampened microclimate to facilitate shedding (Mattison, 1991). This can be accomplished by placing slightly moistened vermiculite, paper towels or sphagnum moss in the hide/nest box or misting the gecko lightly. Creating a micro-humidity chamber is especially important in juveniles which shed as often as every two weeks in comparison to adults which may shed every three to four months. Too much humidity in the captive habitat, however, can create respiratory problems and skin infections, and should be avoided.

DIET

In their natural habitats leopard geckos have been known to eat a variety of arthropods, including scorpions, as well as smaller species of geckos (Tikader and Sharma, 1992). Crickets, mealworms, superworms, and waxworms are all acceptable food items as are insects that are wild caught such as moths and grasshoppers (never feed dead or dying insects to help avoid possible exposure to pesticides). Be aware that some insects are potentially toxic to reptiles such as Monarch butterflies and fireflies. A dietary calcium: phosphorous (Ca:P) ratio of 1:1 to 2:1 is the recommendation for birds and mammals and a Ca:P ratio of 1.25:1 has been found to be ideal in the prevention of fibrous osteodystrophy in this insectivorous species (Allen, 1989). Invertebrate prey species lack a calcified endoskeleton and the chitinous exoskeleton found on many of them is also devoid of calcium. Without dietary supplementation, mealworms, crickets, and wax moth larvae contain very low levels of calcium and have a Ca:P ratio of approximately 0.06:1 to 0.13:1 (Allen and Oftedal, 1982).

Studies have shown that "gut loading" crickets with a diet containing at least eight percent calcium fed for at least 48 hours prior to being used as a food item for reptiles and amphibians would produce a meal that had a Ca:P ratio of 1:1 or higher (Allen and Oftedal, 1989). Crickets that received dietary supplementation of calcium of 8% or greater also had three times the calcium content of those that were dusted with calcium supplement but not gut loaded prior to being used as prey items (Trusk and Crissey, 1987).

Each reptile species may have its own unique dietary requirements for calcium. Leopard geckos that were fed crickets gut loaded for greater than 48 hours with diets containing at least 8% calcium were found to have significantly greater body weights as well as higher bone ash and bone calcium than leopard geckos fed crickets maintained on diets of less than 2% calcium (Allen, *et al*, 1986). Radiographs and histopathology also evidenced better bone integrity in leopard geckos fed higher calcium containing crickets (Allen, 1989). No significant differences in bone ash were attributed to dietary vitamin D3 (Allen, *et al*, 1986). Also, it has been suggested that the insect prey items be offered slices of orange and apple or other food items as a water source. In order to prevent prey items from gut loading these food items in preference to the high calcium diet provided, it is probably more appropriate to provide a water soaked sponge as a water source (Allen and Oftedal, 1989).

Adult leopard geckos should be fed gut loaded prey items at least twice per week. A commercial cricket ration is available from Ziegler Brothers, Inc. (P.O. Box 95, Gardners, PA) that will provide the calcium needed (Boyer, 1993). A gut-loading diet can also be prepared by mixing 80% nutritionally complete chick mash (available in feed stores) with 20% powdered calcium carbonate by weight (Dierenfeld and Barker, 1995). The insect prey items should also be dusted with a calcium carbonate powder (oystershell or cuttlebone) immediately prior to feeding them to the geckos. The Ca:P ratio of dusted crickets has been shown to decrease as time after dusting increased, probably due to the decreased amount of dust adhering to the crickets from movement and grooming (Trusk and Crissey, 1987, Allen and Oftedal, 1989). Dusting with a multivitamin not more frequently than once per week is also recommended. Many supplements contain Vitamin D3 which is important for bone mineralization but excessive amounts can cause soft tissue mineralization in reptiles (Wallach and Hoessle, 1966). Adults can also be fed a pinkie mouse once or twice per month, although this is not

essential. Juveniles and gravid females should be fed appropriate sized gut loaded prey items at least every other day and the prey items supplemented with calcium carbonate at each feeding. Food items should not be longer or wider than the length or width of the gecko's head (de Vosjoli, *et al*, 1998).

A shallow dish of fresh water should be provided daily. The container should be shallow enough to allow hatchlings and juveniles to reach down into the dish to get to the water. Water dishes should be cleaned and disinfected at least weekly and whenever soiled. Reproductively active females will take calcium powder directly from a shallow dish. Also, it is typical for leopard geckos to eat their shed skin and it is not harmful for them to do so.

REPRODUCTION

Leopard geckos are sexually dimorphic and can be sexed as early as one month of age if a magnifying lens is used. Males are generally larger and heavier bodied with slightly larger heads and necks. Hemipenal bulges or swellings are evident at the base of the tail (Figure 5). There is a "V"-shaped row of pre-anal pores positioned cranial to the cloaca (Figure 5). In males the cloacal opening is approximately 20 to 30% wider than in females. Females tend to be smaller with less noticeable pre-anal pits cranial to the cloaca and the tail base is thinner (Figure 6).

Female leopard geckos can begin breeding as early as nine months of age as sexual maturity appears to be a function of size rather than age. Females are able to produce viable eggs when they reach 40 to 50 g of weight. For males, however, onset of fertility seems to be a function of both age and size and occurs at about 18 months of age when they weigh approximately 40 to 50 g. Although successful breeding can occur earlier, waiting until animals are larger and in prime condition will increase the likelihood of high production (de Vosjoli, *et al*, 1998).

The breeding season is from January to September and only one or two successful breedings are necessary to produce fertile eggs throughout a breeding season. It is believed that female leopard geckos have the ability to retain sperm for up to a year (de Vosjoli, *et al*, 1998). Leopard geckos are among the easiest of all lizard species to reproduce in captivity and will readily breed without much preparation. However, some herpetoculturists precondition their leopard geckos by exposing them to a shorter photoperiod and cooler temperatures approximately four to eight weeks prior to breeding. During this cooling period less than 12 hours of daylight are provided and temperatures during the day are 22 - 24°C (72 - 76°F) and 18°C (65°F) at night (de Vosjoli, *et al*, 1998). As with all reptile species, preconditioning and breeding should not be attempted unless the reptile is in optimal health and has been fasted for several weeks.

The second author has set up a three year experiment with two groups of breeder leopard geckos (five males and thirty females in each test group). One group was preconditioned and the other was not. Viable egg production was found to be identical between groups. The preconditioned geckos, however, all seemed to be ready to breed at the same time immediately after temperature and daylight hours were increased. The group that was not preconditioned was not as synchronized and started breeding over a five week period.

There are two breeding methods that are commonly employed in the captive propagation of leopard geckos. Group breeding, where one male is housed with three to six females throughout the year, is much less labor intensive. With this method, monitoring of breeding and determining reproductive efficiency of individual geckos is difficult (de Vosjoli, *et al*, 1998). Another breeding method can be used whereby individual females are introduced into a given male's cage for breeding. This controls who is bred to whom and allows the female to be maintained in a more optimal condition where it may not be as stressed by the continued presence of the hormonally driven males (de Vosjoli, *et al*, 1998).

The average female will produce four to five clutches of two eggs per season with a one month interval between clutches (Mattison, 1991). A healthy, well fed female can produce as many as ten to 14 two egg clutches per year, with an interclutch interval of 17 to 20 days. Fewer eggs are produced as the geckos get older and fertility is decreased (de Vosjoli, *et al*, 1998). A gravid female will have a swollen caudal coelom and two large white bulges can be readily visualized through the ventral body wall (Figure 7). Keep in mind that leopard geckos have bilateral coelomic fat pads that can often be mistaken for eggs. Radiographs may help to distinguish between the two densities if there is a question.

Unlike true geckos the shells of newly laid leopard gecko eggs are soft and sticky (de Vosjoli, et al, 1998, Mattison, 1991). The shells of infertile eggs will remain thin and soft, where as fertile eggs will firm up and have a thick chalky white shell around them (de Vosjoli, *et al*, 1998). Once eggs are laid it is recommended not to change the position of the eggs (i.e. keep the same side up as when they were laid) when moving them into the incubator or during the incubation period.

Eggs will hatch in 6 to 12 weeks depending on incubation temperature. At 27 - 29°C (80.6 - 82°F) virtually all offspring will be female. At 29.5°C (85°F) there will be approximately an equal ratio of male to female hatchlings. At 32°C to 33°C (89.6 - 90.6°F) virtually all offspring will be male (Mattison, 1991).

As with other reptilian species, hatchlings can live off of yolk reserves and generally do not need to be fed until after the first shed which occurs about one week after hatching. Crickets that are 1.3 cm to 1.9 cm (0.5 to 0.75 inches) in length and adult standard sized mealworms are appropriately sized for hatchlings. The gutloaded crickets and mealworms should be offered every one to two days and dusted with calcium carbonate powder immediately prior to feeding. A vitamin mineral supplement should also be used not more often than once per week. Juveniles are usually housed individually in plastic shoe boxes with a hide box and a very shallow water dish. Those kept together exhibit feeding competition, frequent fighting and even cannibalism if they are not fed often enough or not provided adequate hiding places (de Vosjoli, *et al*, 1998, Mattison, 1991).

COMMON MEDICAL PROBLEMS

As with most reptilian and amphibian species, medical problems in leopard geckos are likely to be associated with improper environment and diet. Metabolic bone disease can be evidenced as foreshortened and pliable mandible and

sometimes maxilla. Occasionally fibrous osteodystrophy is noted in the limbs as well. Treatment can be approached as it is for the green iguana.

Gastric and intestinal impaction can be seen with or without rectal prolapse. Sand, crushed walnut shells, fine grade gravels and other substrates that can be easily ingested may cause this problem, and as mentioned before, should be avoided. Abdominal palpation, radiographs, and clinical signs may aid in determining whether medical therapy such as mineral oil enemas, or surgery is necessary. The first author has also seen gastric impaction of six to seven chitinous exoskeletons from supermealworms which were readily eaten when the owner hand fed them to a nine gram leopard gecko.

Shedding problems occur if a moist hidebox is not provided. Distal dysecdesis is common as retained shed constricts around the tail or digits. As the blood supply is impaired by the constricting bands the affected digits or tail may become necrotic and slough off or become infected. It is important that the skin be thoroughly moistened before attempting to remove retained skin. Soaking in moistened paper towels is recommended. Minor skin lacerations may occur and usually will heal if kept clean and treated topically with triple antibiotic ointment. More severe trauma and bite wounds can occur, especially when males and female are kept together. Egg binding may be seen and usually does not respond well to medical treatment. Surgery including salpingotomy or ovariosalpingectomy may need to be performed.

As with all other reptiles, it is important to screen for ecto- and endoparasites. Colonic wash is recommended, if possible, followed by examination of a direct smear and fecal floatation. Cryptosporidiosis has been found in leopard geckos and can be quite contagious. Entire colonies have been lost to cryptosporidiosis.

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All photographs by Tom Weidner, courtesy of David Nieves.

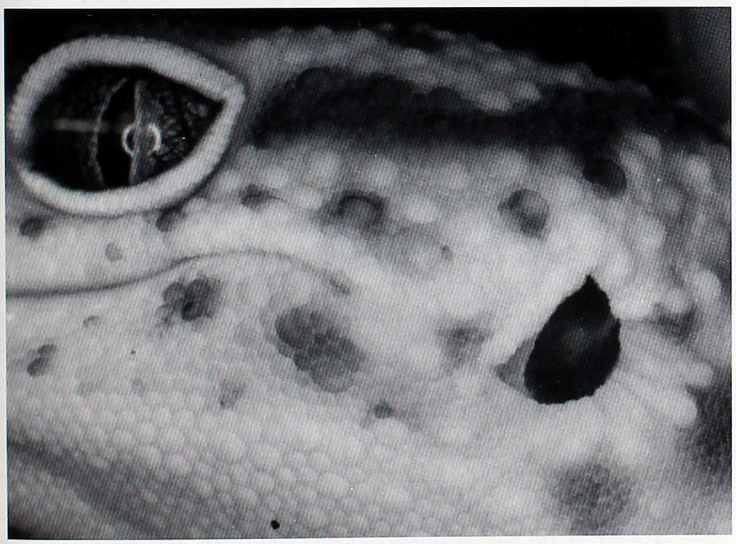

Figure 1. Upclose photo demonstrating the eyelids, vertical iris and large auditory membrane through which light can be shined right through the geckos head.

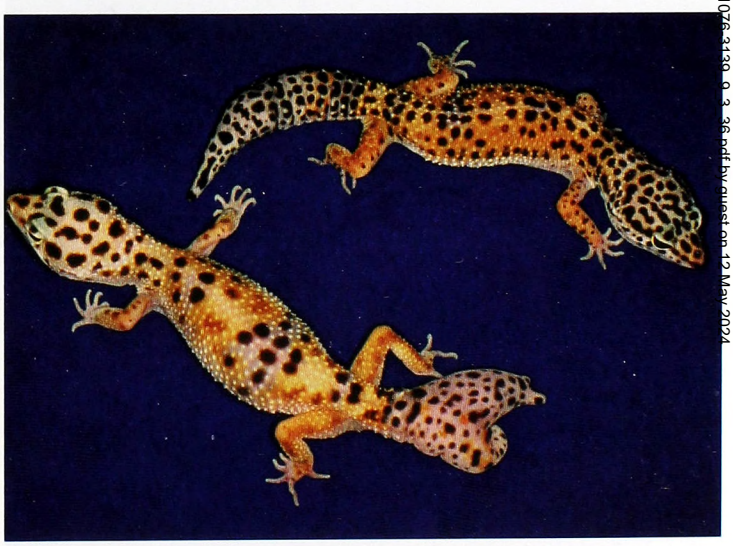

Figure 2. Yellow phase leopard geckos - the gecko on the left lower aspect of the photo exhibits an unusual regrowth pattern of the tail.

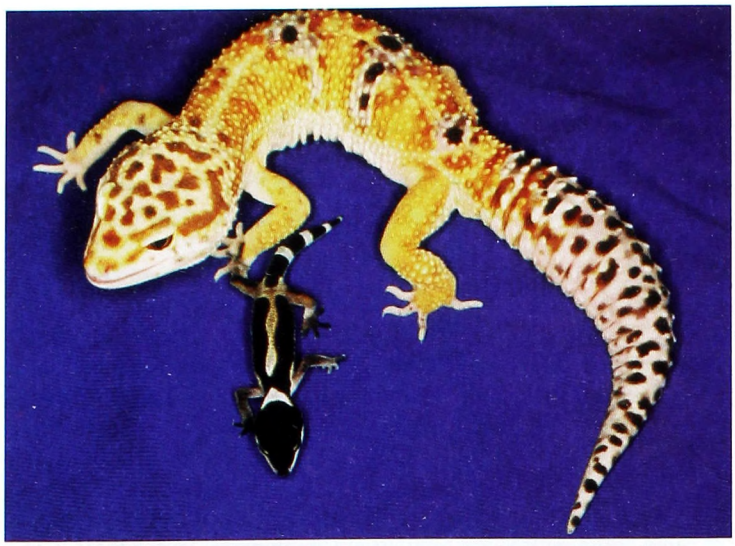

Figure 3. Adult and juvenile yellow phase leopard geckos, *Eublepharis macularius,* showing the striking difference in color pattern at different ages. This color phase has a striped juvenile pattern whereas the brown phase juveniles have a banded tail and body.

Figure 4. Nationally and internationally breeders are trying to work with recessive color traits including the patternless (previously known as leucistic) on the left and the tangello color phase on the right.

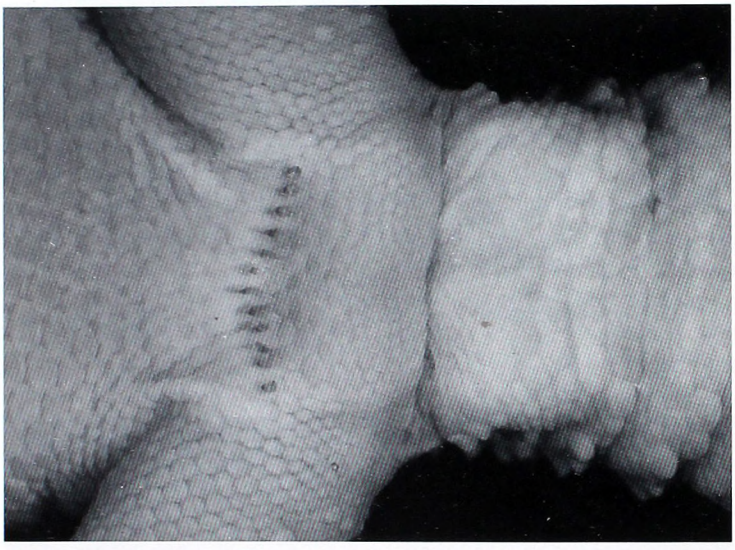

Figure 5. Pre-anal pores are evident cranial to the vent of male leopard geckos, *Eublepharis macularius,*and hemipenal bulges are located at the base of the tail.

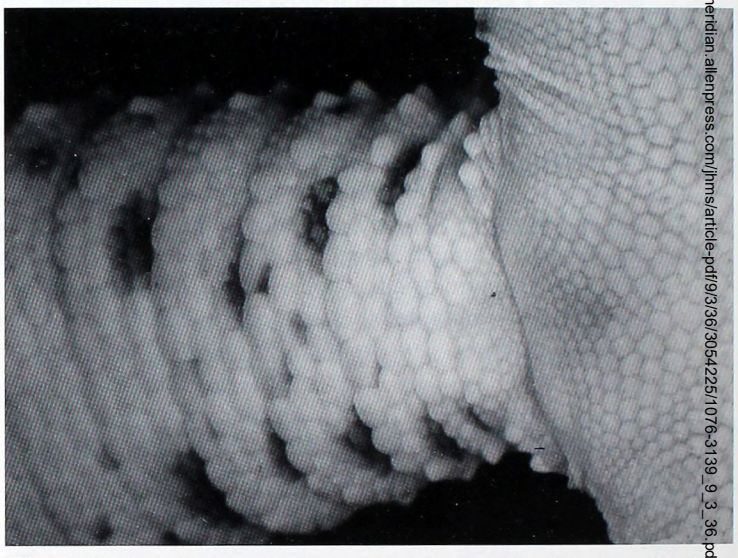

Figure 6. Note the minimized pre-anal pits and lack of hemipenal bulges at the tail base of the female leopard gecko, *Eublepharis macularius.*

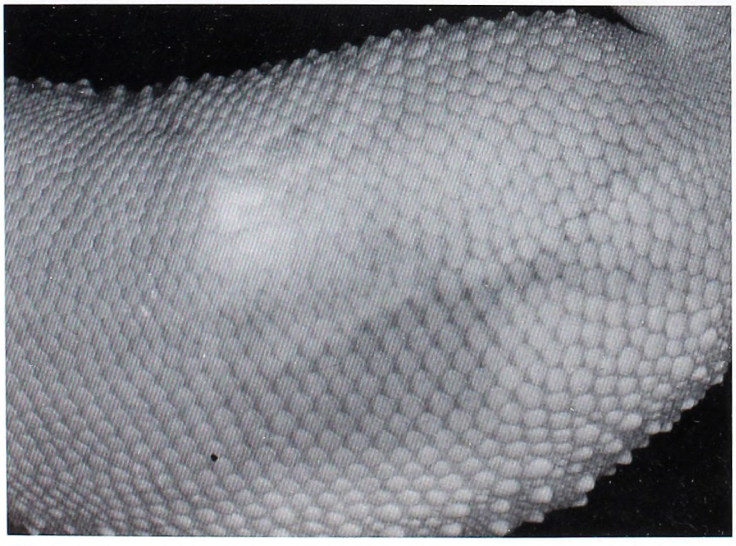

Figure 7. Caudal coelomic swelling and white bulges that can be seen through the ventral coelomic skin are evidence of gravidity.